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(54) **SYSTEMS AND METHODS OF PRODUCING AROMATIC PRODUCTS**

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C07C 7/12	(2006.01)
C07C 7/13	(2006.01)
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CPC . ***C07C 7/005*** (2013.01); ***C07C 2/66*** (2013.01); ***C07C 7/04*** (2013.01); ***C07C 7/10*** (2013.01); ***C07C 7/12*** (2013.01); ***C07C 7/13*** (2013.01); ***C10G 35/00*** (2013.01)

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USPC 585/323, 446, 823, 827, 828, 857, 860; 208/133
See application file for complete search history.

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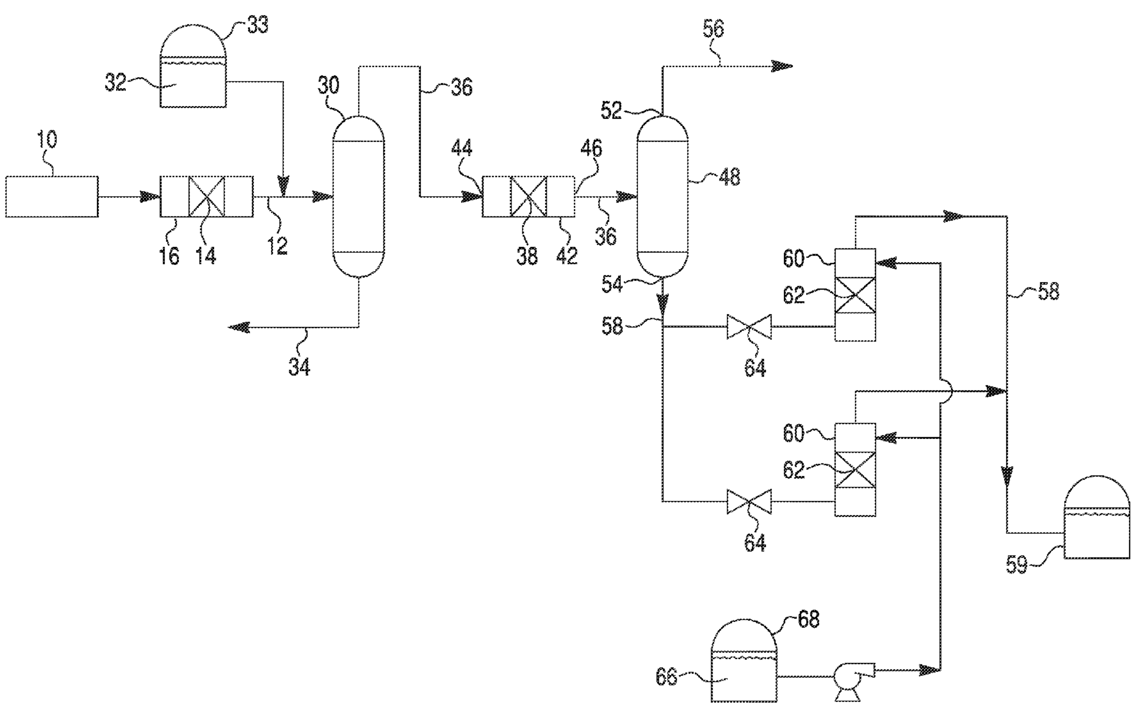
(57) **ABSTRACT**

Systems and methods for producing aromatic products are provided. An aromatic stream is provided with aromatic compounds and olefins. The olefins are reacted with aromatic compounds to form colored bodies, and the aromatic stream is distilled to produce an overhead stream and reboiler stream. The colored bodies are in the reboiler stream, and the reboiler stream is passed through an absorbent to remove the colored bodies.

5 Claims, 2 Drawing Sheets



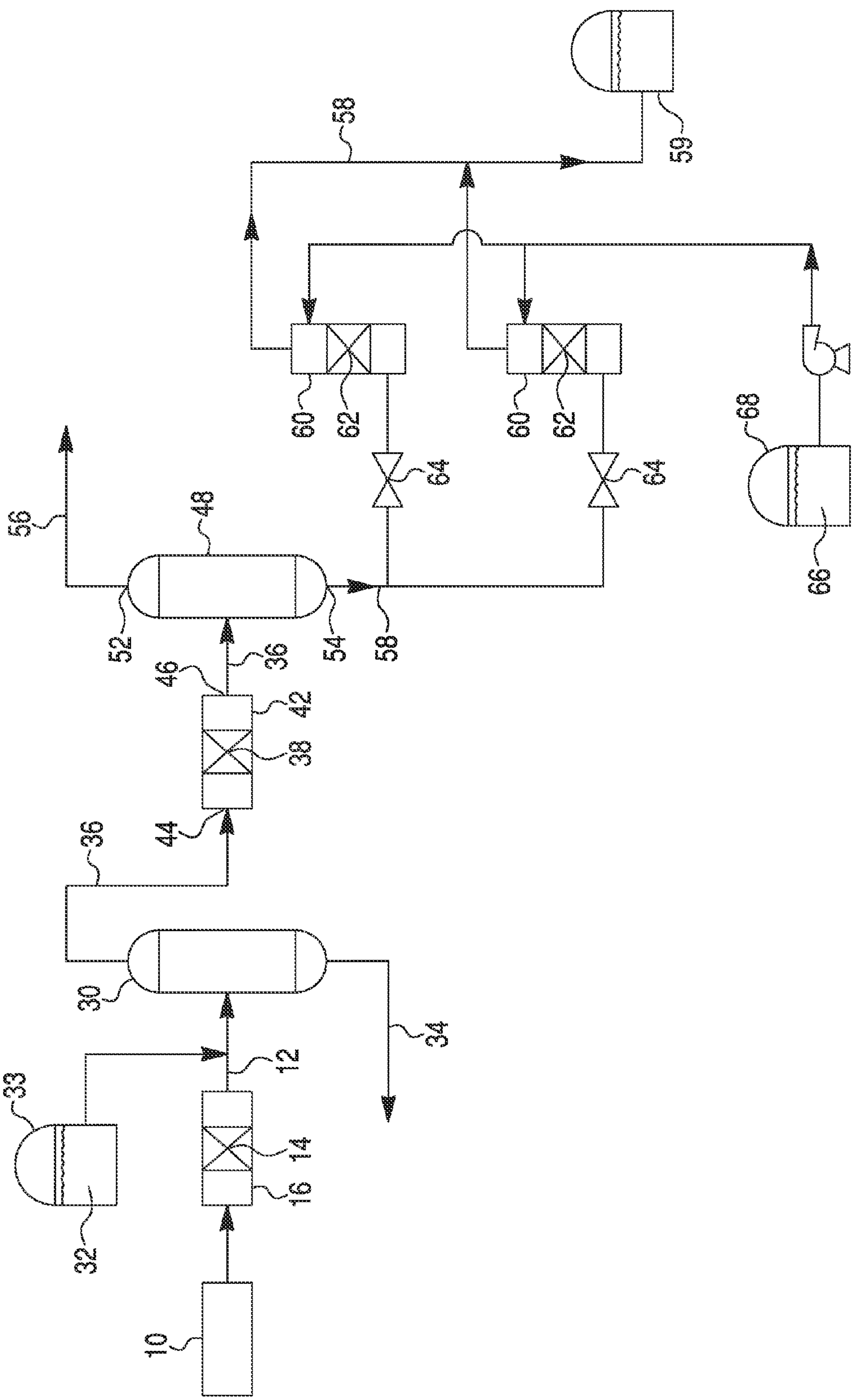

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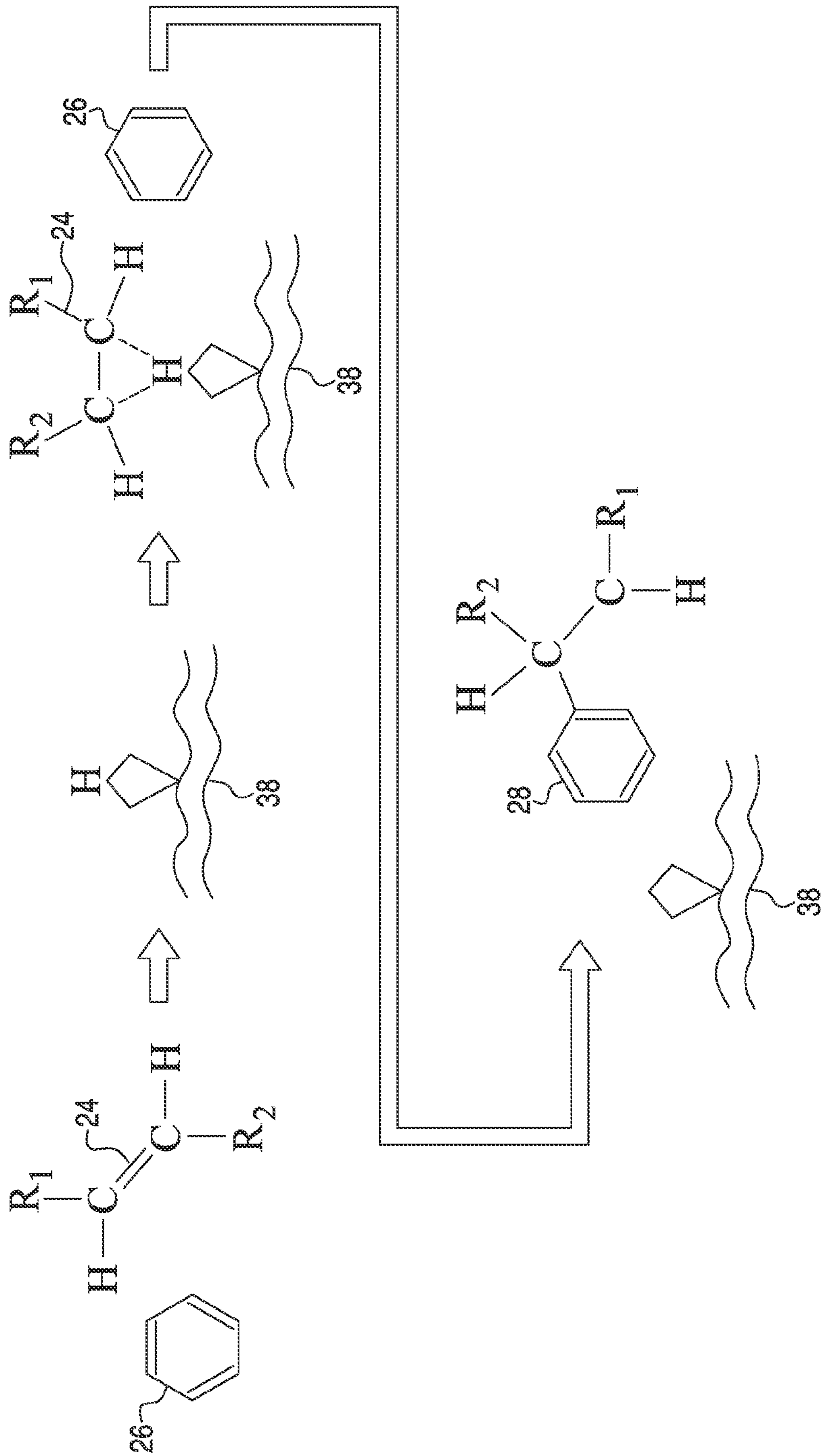
Fig. 1

Fig. 2



SYSTEMS AND METHODS OF PRODUCING AROMATIC PRODUCTS

TECHNICAL FIELD

The present disclosure generally relates to systems and methods of producing aromatic products. More particularly, the disclosure relates to systems and methods for providing aromatic products and removing impurities from those aromatic products.

BACKGROUND

Crude oil is pumped from wells and transferred to refineries for further processing. Many different molecules are present in the crude oil, and these molecules may be separated into various components that have different ranges of molecular weight and volatility. In one embodiment, the crude oil may be separated into light gases, naphtha, and heavy liquids. The naphtha may be used for a wide variety of purposes, including the production of gasoline for motor vehicles, and the production of several specialty chemicals.

Various aromatic compounds can be produced from the naphtha, such as benzene, toluene, xylene, and other aromatics. Aromatic products primarily contain aromatic compounds, but may include small quantities of other materials such as impurities or additives. The aromatic compounds can be isolated and separately sold for many purposes, including industrial aromatic products that may be used as reactants or solvents. The aromatic products are sold under various specifications that specify various properties of the product, such as purity, color, boiling point, distillation range, percent water, specific gravity, and a wide variety of other properties. Various grades or specifications are available, and products with more stringent specifications tend to sell at higher prices. Isolated and highly purified aromatic products are typically more valuable than gasoline, but sales typically depend on the aromatic products meeting specifications.

Olefins are unsaturated hydrocarbons that are not aromatics, but which do contain one or more double bonds. Olefins are a component of naphtha, and they are undesirable impurities in some aromatic products. One method of removing olefins involves reacting the olefins to produce other products that are more easily removed from the aromatics, but some of these reaction products create colored bodies. A small concentration of colored bodies imparts a noticeable color to an aromatic product, and the color may render the aromatic product out of specification. Separation methods can be used, but separation methods require energy, equipment, and processing time, all of which increase the production cost of the final aromatic product.

Accordingly, it is desirable to provide simple, quick, and inexpensive systems and methods for providing and purifying aromatic products. Furthermore, other desirable features and characteristics of the present application will become apparent from the subsequent detailed description and the appended claims, taken in conjunction with the accompanying drawings and this background.

BRIEF SUMMARY

Methods of producing aromatic products are provided. A method of producing toluene includes processing a feed naphtha stream with a naphtha processing unit to produce a processed naphtha stream. The processed naphtha stream is separated into an aromatic stream and a non-aromatic stream, where the aromatic stream primarily comprises toluene and benzene. Remaining olefins in the aromatic stream are reacted to produce colored bodies, and the aromatic stream is distilled to produce an overhead stream and reboiler stream, where the reboiler stream includes toluene and colored bodies. The colored bodies are removed from the reboiler stream by passing it through an absorbent that selectively absorbs colored bodies over toluene.

In another embodiment, an aromatic stream with aromatic compounds and olefins is provided. The olefins are reacted with aromatic compounds to form colored bodies, and the aromatic stream is distilled to produce an overhead stream and reboiler stream. The colored bodies are in the reboiler stream, and the reboiler stream is passed through an absorbent to remove the colored bodies.

A system of producing aromatic products is also provided. The system includes an olefin removal process unit. An aromatic column is coupled to the olefin removal process outlet, and the aromatic column has an overhead outlet and a reboiler outlet. An absorbent bed is coupled to the reboiler outlet, and the absorbent bed includes an absorbent.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments will hereinafter be described in conjunction with the following figures, wherein like numerals denote like elements, and wherein:

FIG. **1** is a process flow diagram of a system for producing an aromatic product in accordance with one embodiment.

FIG. **2** is a simplified diagram depicting an olefin molecule reacting with an aromatic molecule with the aid of an acid catalyst, where R1 and R2 represent hydrogen or an alkane hydrocarbon chain.

DETAILED DESCRIPTION

The following detailed description is merely exemplary in nature and is not intended to limit the application or uses of the embodiment described. Furthermore, there is no intention to be bound by any theory presented in the preceding technical field, background, brief summary, or the following detailed description.

Naphtha is a product or intermediate produced when crude oil is refined. Naphtha is an intermediate weight product that may boil from about 30 degrees centigrade (° C.) to about 200° C., and includes organic molecules that may vary from about 5 carbons to about 12 carbons. However, different grades of naphtha may have different boiling ranges and different molecular size ranges. Naphtha may be reformed to produce aromatic compounds, olefins, and other molecules, and the aromatic compounds may be separated from the olefins in an extraction process unit. Traces of the olefins remain in the aromatic compounds as an impurity, and these olefins may be reacted with the aromatic products to heavier compounds. Some of the heavier compounds are colored bodies that are heavier than the aromatic compounds. The colored bodies are alkylated aromatics, which have an aromatic component attached to a non-aromatic component. The aromatic compounds may be distilled to separate lighter, lower boiling aromatic compounds from the heavier, higher boiling aromatic compounds, and the colored bodies remain with the heavier, higher boiling aromatics. Reference to "lighter" and "heavier" relates to the relative boiling points of the compounds being distilled, where "lighter" compounds boil at lower temperatures than "heavier" compounds. Low concentrations of the colored bodies may impart a color when present in an aromatic product, and color may make the aromatic products off specification. The colored bodies may be removed from the heavy, higher boiling aromatics with an absorbent that preferentially absorbs colored bodies over aromatic compounds. Absorption may be less expensive than another distillation for separating the colored bodies from the heavier aromatics.

Crude oil refining and specialty chemical processing involve many process steps that can be used at many different points in the overall system. Therefore, a description herein of one processing step following another or coupled to another is intended to include zero, one, or more intervening processing steps. Small differences in crude oil sources or other raw materials can result in different process steps or different orders of process steps. The same raw materials can also be used to make different products, which may involve different process steps, a different order of process steps, or modifications of process conditions. The descriptions herein may not describe every detail or every process step used, but instead is intended to guide those skilled in the art, who understand the process variations and additions which may or may not be needed.

Referring now to FIG. **1**, a feed naphtha stream **10** is provided, and the feed naphtha stream **10** may be a component of crude oil or an intermediate or product of crude oil refining. The crude oil can be separated by a distillation technique, and the crude oil may or may not undergo additional processing steps before the distillation. Many different embodiments of the feed naphtha stream **10** are possible, such as heavy naphtha, light naphtha, etc., where the different feed naphtha streams **10** have different components and concentrations of various molecules. Many different types of organic molecules may be in the feed naphtha stream **10**, including straight chain alkanes, branched alkanes, alkenes, ringed alkanes, aromatic compounds, alkynes, etc.

The feed naphtha stream **10** may be further processed in a naphtha processing unit **16** to produce a processed naphtha stream **12**. Many different types of naphtha processing are possible, including reforming, ethylene production, coke production, and others. FIG. **1** illustrates an embodiment with a reforming reactor as the naphtha processing unit **16**, but other types of naphtha processing units **16** could also be used in alternate embodiments. Reforming is a chemical process that changes the molecules in the feed, which is the feed naphtha stream **10** in this case. The reforming process uses a reforming catalyst **14** to re-arrange and restructure the molecules of the feed. Reforming is often used to re-arrange the molecules of the feedstock to produce a higher octane gasoline product, and it may also break some of the feedstock molecules into smaller molecules. Some examples of change from a reforming process include rearranging straight chain alkanes into branched alkanes, converting cyclic alkanes into aromatic compounds such as benzene and toluene, converting alkanes into aromatic compounds, and breaking straight chain alkanes into two or more shorter straight chain alkanes.

Many other changes and modifications are also possible, and the reforming catalyst **14** and process conditions may be adjusted to produce more or less of certain products. For example, in one embodiment the reforming process is set to produce much higher concentrations of benzene and toluene than xylene or heavier aromatics, but in other embodiments the reforming process may be set to produce more xylenes and fewer benzene molecules. The process conditions can also be adjusted to produce more or less aromatic compounds relative to non-aromatic compounds. The reforming process generally produces hydrogen as a by-product, and this hydrogen can be collected and used in other processes. The reforming process also produces olefins, which are non-aromatic organic molecules with a double bond between two carbons. The reforming process may produce light ends, which are small, highly volatile molecules, and the light ends may be vented or removed for separate processing.

In many embodiments, the feed stock is vaporized and pressurized before passing through a bed of the reforming catalyst **14**, and the reforming catalyst **14** may be held in one or more reforming reactors (shown as the naphtha processing unit **16**) during the reforming process. The feed naphtha stream **10**, which may be the feed stock, can be passed through a plurality of reforming reactors, or just one, and the conditions and reforming catalyst **14** may be the same or different in each reforming reactor. Many different modifications or versions of the reforming process are possible, and different versions of the reforming process may be referenced by terms other than reforming, such as platforming.

The processed naphtha stream **12** has aromatic compounds and non-aromatic compounds, including many olefins. In some embodiments, the aromatic and non-aromatic compounds are separated by an extraction process unit **30** that is coupled to the reforming reactor **16**. The aromatic and non-aromatic compounds often are miscible and have similar or overlapping boiling points, which makes simple distillation or liquid/liquid separations ineffective. Many of the aromatic and non-aromatic compounds form azeotropes, which further complicates separation by distillation. The aromatic and non-aromatic compounds often have different uses, values, and requirements. For example, the non-aromatics may be valuable as components in gasoline, and gasoline often has a maximum aromatic specification, especially for benzene.

An extraction process unit **30** may be used to separate the aromatic and non-aromatic compounds. In some embodiments, the extraction process unit **30** uses an extraction solvent **32** to aid in the separation. An extraction solvent tank **32** may be directly or indirectly coupled to the extraction process unit **30** to store the extraction solvent **32** for maintenance. However, in other embodiments, solid adsorbents are used to separate the aromatic and non-aromatic compounds. The extraction process unit **30** may use various processes in isolation or in combination, such as extractive distillation, extractive liquid/liquid separation, or selective adsorption, and the operation of the extraction process unit **30** may vary for different feed stocks. Efficient process steps for separating a large quantity of aromatics from a small quantity of non-aromatic compounds will likely be different than efficient process steps for separating a small quantity of aromatics from a large quantity of non-aromatic compounds. The processes and operation of the extraction process unit **30** are often optimized for specific products and product flows.

In some embodiments, the extraction solvent **32** interacts with one component to change its vapor pressure relative to the other, which makes extractive distillations possible. The extraction solvent **32** may also preferentially dissolve one component over the other, such that a miscible mixture of non-aromatic compounds and aromatics forms two separate layers with one type of material combined with the extraction solvent **32** in one layer, and the other material in the other layer. The extraction solvent **32** typically remains with one of the non-aromatic compounds or the aromatics. After the non-aromatic compounds and the aromatics are separated, the extraction solvent **32** may be recovered and re-used, and distillation is a common method of recovery. Therefore, an extraction solvent **32** with a different boiling point than the materials being separated is desired. Some extraction solvents **32** which may be used for separating aromatics from non-aromatics include tetrahydrothiophene 1,1 dioxide (sulfolane), N-methyl pyrrolidone (NMP), N-formyl morpholine (NFM), ethylene glycols, etc.

The extraction process unit **30** produces a non-aromatic stream **34** and an aromatic stream **36**, where the non-aromatic stream **34** has relatively few aromatic compounds and the aromatic stream **36** has relatively few non-aromatic compounds, and some of the non-aromatic compounds are olefins. The extraction process unit **30** is not **100** percent efficient, so there are some non-aromatics in the aromatic stream **36** and some aromatics in the non-aromatic stream **34**. The non-aromatic stream **34** includes olefin compounds and other non-aromatic compounds, such as alkanes, as well as relatively low concentrations of aromatic compounds. Water may also be present in the aromatic stream **36** and/or the non-aromatic stream **34**, and water may be at concentrations up to or even exceeding the saturation point. In some embodiments, the aromatic stream **36** primarily comprises benzene and toluene, and the components and concentrations of the aromatic stream **36** may have been set by the process conditions in the naphtha processing unit **16**.

The components of the aromatic stream **36** are typically more valuable if they are separated, and one effective separation technique is distillation. Distillation columns typically separate products based on vapor pressure or boiling point, with the lighter (lower boiling) materials travelling through the distillation column and exiting from the column overhead. The heavier (higher boiling) materials do not travel through the distillation column, and are recovered from the reboiler, which is the bottom portion of the distillation column. Olefins having a similar boiling point to the aromatics may distill over with the lighter aromatic compounds and contaminate the distillation column overhead product. However, olefins having a relatively high boiling point remain in the distillation column reboiler and contaminate the heavy aromatic products recovered from the reboiler.

In one embodiment, the olefins in the aromatic stream **36** are reacted to form a heavy molecule that will remain in a subsequent distillation column reboiler, so the overhead product is essentially free from olefin contamination. An olefin reaction process unit **42** reacts the olefins to produce heavy compounds. In some embodiments, the olefin reaction process unit **42** facilitates a reaction of the bromine reactive species to produce heavy compounds, and olefins are a bromine reactive species. FIG. **1** illustrates the use of an acid catalyst reactor for the olefin reaction process unit **42**, but other types of olefin reaction process units **42** could also be used.

The acid catalyst reactor houses an acid catalyst **38**, and the acid catalyst **38** facilitates an alkylation reaction between the olefins (and other bromine reactive compounds) and aromatic compounds, as shown in FIG. **2**. The acid catalyst **38** facilitates the addition of the olefin **24** to an aromatic compound **26**, such as benzene or other aromatics, to produce an alkylated aromatic compound, which is a relatively heavy compound. Some of the alkylated aromatic compounds, which are heavy relative to the aromatic compounds, are colored bodies **28**. Many different olefins **24** and aromatic compounds **26** can be combined, so many variations to the embodiment shown in FIG. **2** are possible. In many embodiments, the acid catalyst **38** is clay, and the clay can be acid activated to improve its catalytic performance. However, other acid catalysts **38** may also be used, and the acid catalyst **38** can be customized to very specifically favor certain reactions, such as aromatic alkylation. The molecular weight of the alkylated aromatic compound is higher than either the olefin **24** or the aromatic compound **26** the olefin reacted with, because the two molecules reacted together to form one molecule, and this tends to produce a relatively heavy, high boiling material. In fact, many of the colored bodies **28** and other alkylated aromatic compounds can be so heavy they are tar-like. The relatively high boiling alkylated aromatic compounds tend to remain with the heavier aromatic compounds **26** in a distillation column reboiler, so the overhead product is essentially free from olefins **24** and alkylated aromatic compounds.

Some of the alkylated aromatic compounds are colored bodies **28**, similar to a dye, and relatively low concentrations of colored bodies **28** can change the appearance of a product. Many pure aromatic compounds **26** are clear, so it is easy to detect impurities that add color. Low concentrations of colored bodies **28** will change the color of many aromatic products, so low concentrations will often bring an aromatic product out of specification. Therefore, an efficient separation process is desired to remove the colored bodies **28** from the aromatic products. The separation process can also separate the alkylated aromatic compounds that are not colored bodies **28**.

Referring back to FIG. **1**, the acid catalyst **38** is held in an olefin removal process unit **42**, which has an olefin removal process inlet **44** and an olefin removal process outlet **46**. The olefin removal process inlet **44** is coupled to the extraction process unit **30** such that the aromatic stream **36** is transferred from the extraction process unit **30** to the olefin removal process unit **42**. The olefin removal process outlet **46** may be coupled to an aromatic column **48**, so the aromatic stream **36** in the olefin removal process outlet **46** is fed to the aromatic column **48**. The aromatic column **48** is a distillation column with an overhead outlet **52** and a reboiler outlet **54**.

The aromatic stream **36** exiting the olefin removal process unit **42** is distilled in the aromatic column **48** to produce an overhead stream **56** and a reboiler stream **58**. The overhead stream **56** exits the aromatic column **48** from the overhead outlet **52**, and the reboiler stream **58** exits the aromatic column **48** from the reboiler outlet **54**. The lighter aromatics are separated from the heavier aromatics because lighter compounds travel through the aromatic column **48** to the overhead outlet **52**, and heavier compounds do not travel through the aromatic column **48** and exit through the reboiler outlet **54**.

In one embodiment, the aromatic compounds **26** in the aromatic stream **36** are primarily benzene and toluene, and the reforming process conditions may have been set for this mix. The benzene is lighter than toluene, so benzene, water, and any other remaining light compounds exit the overhead outlet **54** as the overhead stream **56**, and toluene, the colored bodies **28**, other alkylated aromatics, and any other heavy compounds exit the reboiler outlet **54** as the reboiler stream **58**. The overhead stream **56** is essentially free of olefins **24**, because the olefins **24** were converted to colored bodies **28** and other relatively heavy alkylated aromatics. The benzene or other lighter aromatics are also essentially free of colored bodies **28**, because the colored bodies **28** exit the aromatic column **48** through the reboiler outlet **54**. There may or may not be additional process steps, such as separation of a water layer if present, before the benzene or other overhead stream **56** is sold or otherwise used. In other embodiments, the aromatic stream **36** includes other blends of aromatic compounds **26**, such as toluene and xylenes.

In the embodiment described, the reboiler stream **58** includes toluene and the colored bodies **28**, as well as the other heavy alkylated aromatics. Toluene is a valuable organic solvent used for many purposes, including paint, paint thinner, silicone sealants, rubber, printing inks, adhesives, leather tanners, and many chemical reactants. Toluene is a raw material for toluene diisocyanate, which is used in the production of polyurethane foam. Toluene is also a raw material for the explosive trinitro toluene, commonly known at TNT. There are other uses for toluene as well, such as a fuel or gasoline octane booster. Relatively low concentrations of colored bodies **28** in the toluene may impart a color, which could be particularly undesirable when toluene is used as a solvent for colored products, such as paint, paint thinner, and inks. Many products that use toluene are marketed with specific colors, such as tanned leather, polyurethane foam, and silicone sealants, so colored toluene may not be acceptable for those products because it could impact the final product color. The production and purification of toluene is one valuable aspect of the systems and methods described herein.

The reboiler stream **56** contains the colored bodies **28**, so further processing may be needed to remove color. In one embodiment, the reboiler outlet **54** is coupled to an absorbent bed **60**, which has an absorbent **62** inside. The absorbent **62** selectively absorbs colored bodies **28** over toluene or similar aromatic compounds **26**, such as xylene, trimethyl benzene, or others. The absorbent **62** removes the colored bodies **28** and other alkylated aromatics, so the reboiler stream **58** is essentially free of colored bodies **28** after passing through the absorbent bed **60**. The absorbent **62** may also absorb the alkylated aromatic compounds that are not colored bodies **28**, which further increases the purity of the recovered product. After passing through the absorbent bed **60**, the reboiler stream **58** can be collected and stored in a reboiler stream storage tank **59** for later use, further processing, or sale.

Absorbent **62** which preferentially absorbs colored bodies **28** over toluene or other similar aromatic compounds **26** are available. For example, activated carbon is used to remove colored bodies **28** from other hydrocarbon streams, and in some embodiments the absorbent **62** is activated carbon. Activated carbon can be processed and/or treated in many different ways to modify the absorption properties, so activated carbon could be acquired that preferentially absorbs larger molecules over toluene or other similar aromatics. Activated carbon and other absorbents **62** which tend to absorb larger molecules are sold commercially. Other possible absorbents **62** include zeolites, alumina, silica gels, or activated clays, and these absorbents can also be processed or treated to absorb larger molecules, or to modify the absorption behavior in other ways.

Some absorbents **62**, which may include activated carbon, may absorb water as well as larger molecules. Water is a relatively small molecule, but other factors can influence an absorbent's preferences for different compounds. For example, water is a very polar compound, and the polar nature of water could increase the absorbent's preference for water. Therefore, the absorption bed **60** may be positioned downstream from the reboiler outlet **54**, because water is distilled from the reboiler and exits the aromatic column **48** from the overhead outlet **52**. The presence of water in the feed to the absorbent bed **60** could hasten the exhaustion of the absorbent **62**, because the absorbent **62** may be absorbing both water and colored bodies **28**. Therefore, the absorbent **62** may last longer if water is removed before the colored bodies **28** are absorbed. However, it is possible to position the absorbent bed **60** upstream from the aromatic column **48** in some embodiments.

The absorbent **62** will eventually become exhausted, because the available absorption sites will be filled. Various process options are available when the absorbent **62** becomes exhausted. In one embodiment, the exhausted absorbent **62** is discarded and replaced with fresh absorbent **62**. The reboiler stream **58** could be stored while the absorbent **62** was replaced, or a plurality of absorbent beds **60** (as illustrated) could be coupled to the reboiler outlet **54** so a fresh absorbent bed **60** could be used while the exhausted absorbent **62** was replaced. A valve **64** could be positioned in the line coupling the reboiler outlet **54** to absorption bed **60** so the absorption bed **60** could be isolated or connected to the reboiler outlet **54** as desired. A plurality of valves **64** used with a plurality of absorption beds **60** would allow isolation of a selected absorption bed **60** for absorbent replacement while another absorption bed **60** was in operation. Alternatively, the reboiler stream **58** could be diverted to another use while the absorbent **62** was replaced, or the aromatic column **48** could be shut down while the absorbent **62** was replaced.

In other embodiments, the absorbent **62** may be regenerated instead of replaced. The colored bodies **28** tend to be heavy, and some may be tar-like, so a liquid regenerant **66** could be passed through the absorbent **62**. The liquid regenerant **66** may be used instead of heat for regenerating the absorbent **62** because of the heavy nature of the colored bodies **28** and other absorbed heavy compounds, but heat may useful for absorbent regeneration in some embodiments. The absorbent **62** may preferentially absorb the liquid regenerant **66** over the colored bodies **28**, so the colored bodies **28** would be desorbed and replaced by the liquid regenerant **66**. In other embodiments, the colored bodies **28** are comparably or preferentially absorbed over the liquid regenerant **66**, but sufficient liquid regenerant **66** is passed through the absorbent **62** to desorb and replace the colored bodies **28**. The liquid regenerant **66** may then be desorbed from the absorbent, such as with the application of heat to evaporate or boil off the liquid regenerant **66**, so the absorbent **62** is reactivated. For example, water could be used as the liquid regenerant **66**, and the water could then be removed from the absorbent **62** with heat, but other liquid regenerants **66** could also be used. During absorbent reactivation, the absorbent bed **60** could be isolated from the reboiler outlet **54** using the same process options available for replacing the absorbent **62**, as described above.

The liquid regenerant **66** could be stored in a liquid regeneration tank **68** coupled to the absorption bed **60** for the regeneration process. The liquid regenerant **66** could be returned to the liquid regeneration tank **68** for continued use until it was contaminated with an unacceptable concentration of colored bodies **28** or other absorbed materials. Alternatively, the liquid regenerant **66** could be diverted to other processes or disposed of. The absorbent **62** may not need to be regenerated very often, so a temporary, portable regeneration tank **68** could be used, such as a drum or tote bin. The absorbent bed **60** may include steam coils, steam feed lines, electric heating coils, or other components that may aid in regenerating the absorbent **62**. Steam or heat may be useful in purging the liquid regenerant **66** from the absorbent **62** after the colored bodies **28** have been desorbed.

After the colored bodies **28** and other alkylated aromatics are removed from the absorbent **62**, they may be collected and used for other purposes. For example, the colored bodies **28** and other alkylated aromatics may be used for cutter stock to reduce the viscosity of heavier streams, or they may be used as a solvent for other purposes.

While at least one embodiment has been presented in the foregoing detailed description, it should be appreciated that a vast number of variations exist. It should also be appreciated that the embodiment or embodiments are only examples, and are not intended to limit the scope, applicability, or configuration of the application in any way. Rather, the foregoing detailed description will provide those skilled in the art with a convenient road map for implementing one or more embodiments, it being understood that various changes may be made in the function and arrangement of elements described without departing from the scope as set forth in the appended claims.

The invention claimed is:

1. A method of producing toluene, the method comprising the steps of:

reforming a feed naphtha stream in a naphtha reforming unit to produce a reformed naphtha stream containing aromatics including benzene, toluene, and olefins

separating the reformed naphtha stream in an extraction unit with an extraction solvent selected from the group consisting of tetrahydrothiophene 1,1 dioxide (sulfolane), N-methyl pyrrolidone (NMP), N-formyl morpholine (NFM), and ethylene glycols, into an aromatic stream and a non-aromatic stream, wherein the aromatic stream primarily comprises toluene, benzene and olefins;

alkylating aromatics with olefins in the aromatic stream to produce an alkylation stream containing colored bodies;

distilling the alkylation stream to produce an overhead stream and a reboiler stream, wherein the reboiler stream comprises toluene and colored bodies; and

removing the colored bodies from the reboiler stream by passing the reboiler stream through an absorbent bed containing absorbents selected from the group consisting of zeolite, alumina, silica gel, activated clay, activated carbon, or a combination thereof, wherein the absorbent selectively absorbs colored bodies over toluene to produce a stream comprising toluene and essentially free of colored bodies.

2. The method of claim 1, wherein alkylating aromatics with olefins is in the presence of a clay catalyst.

3. The method of claim 1 further comprising regenerating the absorbent.

4. The method of claim 3 wherein regenerating the absorbent further comprises passing a liquid regenerant through the absorbent.

5. The method of claim 1 wherein removing the colored bodies from the reboiler stream further comprises passing the reboiler stream through an absorbent primarily comprising activated carbon.

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